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On the Marking Behavior of the Kinkajou (*Potos flavus* Schreber)

Ivo Poglayen-Neuwall[1]

(Plates I-III)

Introduction

UNTIL recently, the function and purpose of the conspicuous glandular organs of the kinkajou were the subject of conjecture (Pocock, 1921; Fiedler, 1957) and not corroborated by actual observations. The writer has kept a number of kinkajous since 1956 and has been able to make several observations on their marking behavior (Poglayen-Neuwall 1962) which, with further observations, bring this complex problem closer to a solution.

Three of eight males and one of four females studied demonstrated repeatedly typical marking behavior. It is noteworthy that all animals which marked were born and raised in captivity (Albuquerque Zoo), and that none of these animals was observed marking while in the large outdoor cage; this was true of those living there permanently (during the warm season) as well as those introduced and reintroduced at different times. The animals, singly or in pairs, spent frequent brief periods (15 minutes to about three hours) romping at large in the writer's home during which times they were under constant observation. It was only then that any animal was seen to display marking behavior.

In October 1965, a pair of kinkajous was donated to us by the Memphis (Tennessee) Zoo. The animals, born in that zoo nine and three years earlier, were received at the Louisville Zoo and maintained in a 6 x 6 x 6 foot indoor cage, where they soon exhibited a pattern of scent-marking.

Observations

All three known skin glands, the paired mandibular gland, the throat gland and the abdominal gland, are used for marking. The first two glands, at least, also constitute, as described elsewhere (Poglayen-Neuwall *op. cit.*), organs for sexual stimulation.

The animals displayed normal behavior, including marking, only during their activity phase in the evening and at night. Marking was not correlated with a specific time of year, and breeding, in captivity and probably in the wild, is not seasonal (Poglayen-Neuwall *op. cit*). Asdell (1964), however, suggests a main whelping season from May to September, with one litter recorded for April and one for December.

In the writer's home the following kinds of marking[2] took place:

a) Mandibular glands (one or both glands, alternately) were used to mark the rounded legs of a table, a door knob, the lower part of a telephone receiver, and the writer's shoe. Marking was accomplished by rubbing the glandular plate once or repeatedly in a caudad direction upon the object. The Memphis female very frequently marked the vertical corner pipes of her cage (preferably the ones pointing towards the service area) by pressing or, less often, wiping briefly with one of the mandibular glands. Within a few weeks a dark brown layer of secretion, sebum and dirt had accumulated on the lower part of these preferred "marking posts." The male was rarely observed marking. When doing so he used the female's posts.

b) The throat gland was employed to mark a certain pillow (or a substitute pillow as long as it was in the location of the original one), the telephone, the upper rim of a wooden box, the upper edge of the back of the couch, and the occipital region of my wife. This marking was

[1]Director, Louisville Zoological Garden, City Hall, Louisville, Kentucky.

[2]Most of the objects marked were characterized by rounded contours.

either a simple, slight wiping action or a repeated sweeping of the gular region in one direction with noticeable pressure, from somewhat forward of the sternum toward the animal's throat.

After being placed in the cage of two females known to him only by sight, the Memphis male demonstrated very intensive marking behavior by frequently pressing his throat gland with the head held straight up against the vertical corner pipes, and also by pressing or, less often, wiping with the gland on the largest climbing limb. This behavior was noticed beginning on the second day after his transfer, and it lasted until the time of his removal because of incompatibility five days later. Moved into an unfamiliar cage and kept by himself, he immediately ceased to exhibit this marking pattern.

c) A kinkajou, standing on its hind legs upon the seat of a couch, rubbed the abdominal glandular area against the thigh of my wife as she stood next to the couch. The animal, assuming a prone position, also marked the upper edge of the back of the couch. Marking took the form of an antero-posterior thrusting of the abdomen on the supporting base.

An unusual observation was made on the Memphis female, who was kept at the time with her five-week-old female cub. Since the arrival of the adult pair from Memphis nine months earlier, two adult female kinkajous had been kept in a cage three feet from the cage housing the pair. At the birth of the baby the Memphis male was removed and housed separately in an adjacent room. On four successive nights the Memphis female was seen marking fresh food objects. Twice it was a whole, peeled banana and twice an unpeeled quarter of an orange. The marking followed a general routine. After the animal finished part of her food ration, she took one banana (or orange section) from the feeding pan, placed it on the cage floor, and stepped with both hind feet on the fruit. She remained in this position for from two to three seconds; she then stepped backward and, bending the forelegs, dragged her abdomen over the fruit in backward direction from the perineum to the sternum. Thereafter the abdomen was raised and brought forward again without touching the fruit. The same movements were repeated two more times. Once this marking procedure was somewhat altered; in addition to the backward dragging or rubbing, the animal also marked while moving forward. The animal stepped on the fruit after each of the three backward-forward movements.

The sequence of frequency in marking involved first the mandibular glands, then the throat gland, and last the abdominal gland. The youngest kinkajou observed to manifest marking behavior (with mandibular glands) was a young male, 92 days old; this is long before sexual maturity, which is assumed to be attained at about 16-18 months.

Discussion

The following possible interpretations of the significance of the glandular organs in the biology of the kinkajou suggest themselves:

1) Demarcation of the boundaries of the home range (or a territory) for the individual, the pair, the family, or the band. The glandular secretion has a deterrent effect on the competitor for food or the sexual rival.

2) Scent used in defense against predators.

3) Marking of trails.

4) Scent as a means in intraspecific relationships (rank order, identification).

5) Secretion with sexual significance.

a. Facilitation in meeting of the sexes.

b. Marking of the sexual partner during the mating period.

c. Glandular secretion as a sexual stimulant.

Field observations (Anthony 1916, Enders 1935, Gaumer 1917, Goldman 1920, Poglayen-Neuwall 1962, and Handley, personal communication, 1964) make it seem unlikely that kinkajous possess a "territory" (as defined by Burt, 1943) which the individual or the social group defends against intruders of the same species or the same sex. Kinkajous do not form well-organized social groups. Whether or not they are at times gregarious, forming perhaps loosely organized bands composed of several individuals of both sexes, a family group, a pair, or a female with young, still is not known with certainty. Naturalists report having seen kinkajous in pairs, in bands, and less often as solitary individuals. It is certain that a number of animals may form feeding groups on fruit-bearing trees. The fact that strange males, as a rule, may be put together and kept in one enclosure (including one with females) may be indicative of the animals' sociability. Only a few cases of incompatibility among adult males are known to me. Fighting between an old male in an established captive group and a newly introduced male resulted in serious injury inflicted to the latter (Trebbau, personal communication, 1962). Males born in a group of kinkajous at the West Berlin Zoo had to be removed when two years old because of damaging fights among each other and/or the old breeding male (Klös *in litt.* 1966). It should be mentioned that the quarters at West Berlin Zoo were quite small for the number of animals therein confined.

A theory which must be considered is a possible random marking within the home range; this may not be done alone for the demarcation of a home range, but perhaps more so for personal identification, thereby helping to keep the individuals of the band in contact. Marking is not a part of the nuptial display as the urine-rubbing described for male coatis, *Nasua narica,* in the breeding season (Kaufmann 1962), nor does the marking of the kinkajou belong to the pattern of threat and fighting behavior as in many rodents, *e.g.* the non-territorial guinea pig (Kunkel & Kunkel 1964).

Occasionally kinkajous of the same or opposite sex, when being introduced, will sniff at each other's throat glands or mandibular glands. Apparently this behavioral trait helps in recognizing and identifying an individual. After a three-week separation the female from Memphis was reintroduced to her mate. Very intensive mutual olfactory inspection was at once noticeable, with the female chirping almost constantly. The male inspected the following areas of the female in decreasing order of intensity and frequency: nape, throat gland, mandibular glands, abdominal gland, and perineal region. The female checked the male's mandibular glands, penis, abdominal gland, and throat gland. At a later time when the male was returned to the cage containing the female, essentially the same olfactory display took place, but with the chirping female being the slightly more active individual.

As is well known, kinkajous emanate a clearly perceivable musk-like odor which cannot be traced to a particular glandular area. It is not known if this odor and/or the glandular texture make the kinkajou distasteful to a predator, but I am inclined to think that this is not so. Kinkajous do not possess any musk glands which emit secretions explosively like some of the mustelids, or strongly odorous, anal musk like *Bassariscus astutus* (Edwards 1955, Kaufmann 1965, *in litt.*). In fact *Potos* is reported not to have anal glands (Pocock *op. cit*).

Since both sexes possess the above-mentioned skin glands and since we know that sleeping sites or nests can be located at considerable distances from feeding sites, there may be the possibility of scent-marking trails. Eibl-Eibesfeldt (1953) assumes that the greater galago *(Galago crassicaudatus)* scent-marks trails in the tree tops, but in that instance marking is done with the palms of hands and feet which are actively impregnated with urine. Ilse (1955) describes similar observations with *Loris tardigradus.* Fiedler (1957) elaborates in great detail on the scent-marking with secretion of the anal glands in both sexes of the lesser panda *(Ailurus fulgens)* on objects along definite trails in trees and on the ground. Marking on the ground with anal gland secretion by male coatis *(Nasua),* a gregarious species, is reported by Fiedler *(op. cit.)* but denied by Kaufmann (1962 and pers. com. 1963). In this context two other species of procyonids should be mentioned also. The cacomistle *(Bassariscus astutus)* is said to derive its characteristic sweetish-musk body odor through secretion from the anal glands. According to Richardson (1942), "the fluid appeared when the animal was frightened. . . . The species, as far as I have seen, makes no effort to throw or wipe the fluid on objects with which it comes in contact." In contrast Fiedler (*op. cit.*) described marking by the male over protruding points of branches, supposedly by means of a discharge from the anal glands. Kaufmann (1965, *in litt.*) relates observations of a captive mature male "standing on the floor on his hind legs and resting his forepaws on the vertical branch, then rubbing up and down much like a coati rubbing urine. The branch is visibly wet afterwards. I have never seen him rub his anal region on anything." From the little that is known of the natural history of this species it appears that cacomistles live alone or in pairs, and thus the frequent marking activity throughout the year serves in this case to determine the boundaries of the territory of the individual or pair. Poglayen-Neuwall & Poglayen-Neuwall (1965) give an account of the marking with urine by both sexes of the olingo *(Bassaricyon),* whose anal glands are modified to serve as a means of defense, releasing a foul-smelling liquid. *Bassaricyon,* which is apparently not a sociable species may use urine-rubbing for marking trails leading through the tree tops, possibly for territorial marking in both sexes outside the breeding seasons.

The marking of one or several trails, as well as particular objects within the home range, could further the meeting of the sexes, especially if we assume that kinkajous are more or less solitary, at least during part of the year. The marking activity is independent of the sexual cycle, in contrast to the European pine marten, *Martes martes* (Landowski 1961).

Some mammals such as the Waller's gazelle, *Litocranius walleri* (Walther 1958), show a rather aberrant behavior pattern; in this species the male actively marks the female with scent from his antorbital glands during the mating season. Recently, very interesting observations on *Petaurus* were reported (Schultze-Westrum 1964). The flying phalanger possesses a frontal and a sternal glandular organ. These glands, as well as the urine, convey, according to Schultze-Westrum (*op. cit.*) three individually differentiated scents. The secretions are used primarily for

self-odoration and for the marking of individuals of their own clan; thus a clan-specific odor spectrum is established within which the odor of strong males is dominant, whereby, without any fighting, a rank order can be established and maintained. Marking is used only secondarily by males for the determination of a territory. It is not known if the glands of *Potos* produce individually distinguishable secretions for each gland, but prolonged observations make marking of one animal by another appear highly improbable.

It seems almost certain that one function of the glandular secretion can be that of sexual stimulus at the beginning of the copulatory act. Repeated observations, photographically recorded, tend to support this theory (Poglayen-Neuwall 1962). The licking of secretion of the sexual partner as an appetitive behavior for the mating activity which frequently follows does not seem to be compulsory, however. Another breeding pair of kinkajous was observed several times copulating and on two of these occasions the male showed nothing of this peculiar behavior so characteristic of the Albuquerque male.

Conclusions

Concurring with the assumption of Enders (1935), Gaumer (1917), and others that kinkajous in their habitat form loose bands, and knowing that both sexes display behavioral patterns of scent-marking which are not correlated with a particular seasonal breeding period (the species is polyestrous), the following assumptions can be made:

a. Marking activity occurs within the home range to facilitate contact within the social group, and/or

b. Marking of trails occurs from the sleeping den to the feeding sites.

No definite answer to the exact purpose(s) of this species' marking display with its three differentiated dermal glands can be given so long as we lack the technical equipment which would enable us to observe this strictly nocturnal and arboreal species more closely and continually over a longer period of time in its native habitat.

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EXPLANATION OF PLATES

Plate I

Female kinkajou marking with mandibular gland.

Plate II

Female using mandibular gland for marking.

Plate III

Male marking with throat gland.